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Estimation of Retail Product of Carcass Beef

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Summary

Carcasses from 1,121 steers (progeny of Hereford or Angus cows mated to Hereford, Angus, Charolais, Simmental, Limousin, South Devon, or Jersey sires by artificial insemination) were examined to develop equations to estimate percentage of retail product. The independent variables chosen and resultant accuracy of the equations developed, reflect different kinds of measurements that could be used to predict cutability over a wide range of data collection conditions.

Of 18 traits readily obtained in the cooler, adjusted fat thickness, rib eye area, estimated kidney and pelvic fat, hot carcass weight, and marbling score were the most important in predicting percentage of retail product. A multiple regession equation involving these five independent variables accounted for 79.2% of the variation in percentage of retail product.

Results showed that adequate alternatives other than complete cutout of carcasses do exist to determine yields of retail product. Reasonably precise estimates of percentage or retail product can be made based on prediction equations involving independent variables measured on carcasses in the cooler alone or in combination with partial cutout data. These estimates should be especially useful when a large number of carcasses are to be evaluated.

Introduction

Retail product yield is a useful measure of the saleable portion of carcass beef. Time and resources are often not available to obtain actual retail yields. Thus, reliable estimates of retail product yield are needed in marketing, progeny testing, and in research programs.

Numerous equations for estimating percentage of carcass cutability have been developed on carcasses derived from British beef, dairy, and Brahman breeding. The present USDA (1965) yield grade equation estimates percentage of closely trimmed, boneless round, loin, rib, and chuck (Murphey *et al.*, 1960). In this regression equation, independent variables are those that can be measured rapidly with minimal expense on carcasses in the cooler. When tested on independent populations of carcass beef, it has been found to be useful on carcasses derived from animals having the same growth and fattening patterns.

The purpose of this study was to develop prediction equations to estimate retail product for carcass beef derived from steers varying in rate and composition of growth. Predictors chosen reflect different situations relative to resources available to make required observations.

Data were obtained from 1,121 steer calves born in 1970, 1971, and 1972 as part of a cattle germ plasm evaluation program for beef production. Hereford and Angus cows were mated to Hereford, Angus, Charolais, Limousin, Simmental, South Devon, and Jersey sires by artificial insemination. Calves were stratified within sire breed groups by age and assigned to one of three slaughter groups each year (215, 243, and 271 days postweaning for 1970; 200, 242, and 284 days for 1971; and 220, 245, and 283 for 1972).

Yield grade and quality grade factors and linear measurements were determined 24 hr postmortem. Muscling was scored from 1 (extremely thick) to 10 (extremely thin). Carcass length, hindquarter length, round length, round thickness, chuck thickness, and chest depth were measured.

The right side of each carcass was taken to Kansas State University and processed into retail cuts trimmed to no more than 0.3 in fat cover. Dorsal and transverse spinous processes remained in the short loin cuts, and dorsal spinous processes and rib bones remained in the rib roast. All other retail cuts were made entirely boneless. Kidney and pelvic (K and P) fat of the right side was weighed and expressed as a percentage of the right side weight. Percentage of retail product was determined by dividing the weight of the trimmed retail yield from the round, loin, rib, and chuck plus lean trim from the entire side by the sum of individual weights of all side componets. Percentages of rib retail product, rib fat trim, round retail product, and round fat trim were expressed relative to weights of their respective wholesale cuts.

Results And Discussion

Regression equations with standard errors and coefficients of determination for predicting percentage of retail product are given in Table 1. An R^2 is the variation accounted for by a prediction equation divided by the total variation. It is, therefore, a measure of the accuracy of the prediciton equation. Equations are presented on an overall breed of sire subclass basis and a pooled within-breed of sire subclass basis. Inferences from the overall analysis would be applicable to a population of carcasses similar to those of the breed groups sampled in the present study. Results from the pooled within analysis represent the average response within the seven sire breed groups. Differences in standard errors and coefficients of determination of equations developed by the two subclass basis are largely due to the reduction in variation associated with breed group means. Independent variables presented are those that were found to be the most important by stepwise regression procedures and to be of practical usefulness in various resource situations where observations may be made in the cooler, on partial cutout of the carcass, or on chemical analysis of the 9-10-11th rib sections. Additional independent variables were significant and made some improvement in the R^2, but these contributions were negligible and of little practical consequence.

Equations 1 through 4 (over all subclasses) and equations 9 through 12 (within subclasses) involve independent variables observed in the cooler, which can be obtained with rapidity and with modest expense. These equations involve traits found in the yield grade equation with the addition of marbling score. Equations 1, 9, and 11 omit hot carcass weight. The usefulness of hot carcass weight in an equation representing all breed groups is somewhat questionable. This is due to the negative effect heavier carcasses have on predicted percentage of retail product.

Measurements of length and thickness of the carcass or components of the carcass made no practical contribution to the R^2 when marbling score was included in the equation. Subjective measurements of carcass muscling were important. However, if marbling score was included in the equation, then the contribution of muscling score was minimal.

Preliminary correlation analysis of closely trimmed wholesale cuts with percentage retail product indicated that the wholesale round and the rib cuts were the best indicator of closely trimmed carcass retail products. Consequently, regression equations were generated utilizing independent variables derived from cooler observations and partial cutout of the round and rib. Equations 5 and 13, involving percentage of trimmed round and percentage of retail product of the round, respectively, incorporated adjusted fat thickness and the actual percentage of K and P fat. Variation in actual K and P fat was more highly associated with variation in retail product than estimated K and P fat as shown by the results of the correlation analysis. Processing the round would require removel of K and P fat from the

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hindquarter. Therefore, actual K and P fat could be determined and errors due to estimation would be removed. Equation 5 and 13 accounted for 86.1 and 79.1% of the variation in percentage of retail product on an overall breeds of sire and on a pooled within breeds of sire subclass basis.

Equations 6 and 14 (involving adjusted fat thickness (FT), estimated percentage of K and P fat, marbling score, and percentage of rib fat trim) were not as accurate or reliable as equations 5 and 13 in which partial cutout of the round was used. However, equation 6 did account for 80.2% of the variation in percentage of retail product, and observations were obtained with rapidity and minimal resources requiring less labor.

Ether extract of the 9-10-11th rib, in addition to adjusted FT, longissimus area (LA), and percentage of K and P fat, was used in equations 7 and 15 and accounted for 85.5% of the variation in percentage of retail product over all breeds of sire. Equation 7 was a significant improvement over equation 1, increasing the R^2 by 10.1% and reducing the standard error by 23.8%.

Equations 8 and 16 (involving independent variables: adjusted FT, actual percentage of K and P fat, percentage of round retail product, and percentage of ether extract of the 9-10-11th rib) provided the best fit. The two equations accounted for 89.5 and 84.0% of the variation in percentage of retail product overall and pooled within-breed of sire subclasses, respectively. Standard errors of the respective equations were 1.44 and 1.40%. Equation 8 should provide a useful alternative to complete carcass cutout for determining retail product where a small error in estimation can be tolerated.

The results of this study indicate that adequate alternatives exist to complete carcass cutout to obtain retail product. The accuracy and reliability of these alternatives are related to the amount of time and resources provided for labor and instrumentation required to make carcass observations. However, estimates adequate for many purposes, namely, group averages involving a large number of observations, can be made with minimal input. The level of precision required of an experiment in which retail product is to be observed can be predetermined. Experimental design and a method of making this observation with minimum inputs at the required level of precision can be selected.

Table 1.—Regression equations for predicting percentage of retail product

Equation number	Subclass basis	N	SE	R^2	Intercept	Adj. FT (in)	Longissimus area (in^2)	K & P K & P fat (%)	Carcass weight (lb)	Marbling score[1]	Actual K & P fat (%)	Trimmed round (%)	Round RP (%[2])	Rib fat trim (%)	Rib ether extract (%)
						Partial regression coefficients									
1	Overall[3]	1121	2.23	0.754	74.9	−17.8	0.55	−1.47	0	0	0	0	0	0	0
2		1121	2.18	.765	75.6	−16.1	.86	−1.42	−.008	...	...	...	...	...	...
3		1121	2.11	.780	76.1	−16.5	.56	−1.23	...	−.234	...	...	...	...	...
4		1121	2.05	.792	77.0	−14.7	.89	−1.17	−.009	−.240	...	...	...	...	...
5		1121	1.68	.861	1.9	−8.2	...	...	...	...	−.78	.89	.70	...	...
6		1121	2.00	.802	85.1	−9.3	...	−1.15	...	−.219	...	...	...	−.403	...
7		334	1.70	.855	87.0	−8.0	.33	−.70	...	...	...	...	...	...	−.399
8		334	1.44	.895	37.4	−5.7	...	...	...	...	−.911	...	.65	...	−.296
9	Within[4]	1121	2.08	.655	75.8	−17.2	.36	−1.18	...	...	...	...	...	...	...
10		1121	2.02	.673	77.2	−14.6	.67	−1.06	−.010	...	...	...	...	...	...
11		1121	1.99	.687	76.8	−16.1	.42	−1.07	...	−.215	...	...	...	...	...
12		1121	1.92	.705	78.3	−13.5	.72	−.95	−.010	−.215	...	...	...	...	...
13		1121	1.61	.791	34.2	−14.0	...	...	...	...	−1.20	.53	.44	...	...
14		1121	1.84	.730	83.3	−9.4	...	−.85	...	−.186	...	...	...	−.363	...
15		334	1.65	.781	86.2	−8.5	.34	−.68	...	...	...	...	...	...	−.377
16		334	1.40	.840	35.3	−5.6	...	...	...	...	−.85	...	.66	...	−.269

[1]Scored small− = 10, small⁰ = 11, small+ = 12, et cetera.
[2]Percentage retail product of the round.
[3]Regression equations were computed over all breed of sire subclasses.
[4]Regression equations were based on a pooled within breeds of sire subclass sums of squares and cross products matrix.